

# PRINCIPLES OF TRANSDUCER DEVICES AND COMPONENTS

**Edited by**

**Sheroz Khan, International Islamic University Malaysia**

**Jalel Chebil, International Islamic University Malaysia**

**Othman O Khalifa, International Islamic University Malaysia**



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## Chapter 11

### MAGNETIC PROPERTIES FOR MAGNETIC TRANSDUCER

ATIKA ARSHAD, RUMANA TASNIM, SHEROZ KHAN, AHM ZAHIRUL ALAM

#### 11.0 INTRODUCTION

Knowing the basic terminology for describing magnetic effects and properties are essential since magnetic materials can be used in inductive sensors as in the form of core. The various types of magnetic behaviour and properties of hard and soft magnetic materials (used in inductive sensor) need to be identified in order to decide on the appropriate applications in biomedical and industrial field.

#### 11.1 MAGNETIC MATERIALS

Magnetism is a well-known phenomenon by which some materials attract and others repel. Generally magnetic forces are generated by moving charged particles thus producing magnetic fields. The atomic movement in the material will respond to an external magnetic field. The external magnetic field is denoted by  $H$ , the magnetic induction in the material is denoted by  $B$  (tesla) and the magnetization by  $M$ .

$$B = \mu_0(H + M) \quad (11.1)$$

Where  $\mu_0$  is the permeability of free space and  $M$  is the magnetic moment  $m$  per unit volume of the material. The value of  $M$  depends on the type of material. Moreover every material responds differently to the force of a magnetic field. There are three main classifications of magnetic materials. A magnet will strongly attract ferromagnetic materials, weakly attract paramagnetic materials and weakly repel diamagnetic materials.

#### 11.2 CLASSIFICATION OF MAGNETIC MATERIAL

A magnetic material falls under five different categories: diamagnetic, paramagnetic, ferromagnetic, anti-ferromagnetic, and ferri-magnetic, as shown in Figure 11.1 and Figure 11.2. Diamagnetic materials are those in which individual atoms or ions do not have net atomic or molecular movement, thus when diamagnetic material is placed in an external magnetizing field, it gets weakly magnetized in a direction opposite to the magnetizing field. Antimony, bismuth, copper, diamond, gold, mercury, silver, sulphur, tin and zinc are examples of diamagnetic material.